REPLACABLE WEAR SURFACE FOR BIT SUPPORT

Cross-Reference to Related Applications

The present application is a continuation-in-part of my co-pending application S/N 10/171,939 filed June 14, 2002.

Background of the Invention

The present invention relates generally to road milling and trenching machines and more particularly to apparatus for preventing wear on the face of blocks or holders that are used for retaining cutting bits on such road milling, trenching and other machines.

Conventional road milling and trenching machines utilize cutting bits mounted in cutting systems that in normal operations move with respect to a work surface. The cutting systems typically include a plurality of cutting bit holders or blocks that include a bore. Each of the cutting bits includes a cutting surface located at a forward or distal end of the cutting bit that is intended to contact the work surface to mill or mine material from the work surface. Each of the cutting bits also includes a shank located at a rearward or proximal end of the cutting bit that is received in a bore in a cutting bit holder or block.

During use, impacts between the cutting bits and the work surface cause the cutting bits to rotate with respect to the holder. The impact induced rotation also causes relative movement between confronting surfaces of the cutting bit and holder. The environment in which such machines are typically operated generally includes abrasive particulate materials that are displaced from the work surface and can be entrained between the confronting surfaces of the cutting bit and holder. The relative movement in the presence of the abrasive particulate materials causes significant frictional wear that can result in a variety of failure modes for the cutting system.

Attempts have been made to focus the wear on cutting system elements that are easily replaced, such as the cutting bits, rather than on

the system elements that are more or less permanent portions of the cutting system, such as the cutting bit holders. For example, the cutting bit shank is typically rotatably mounted within a sleeve that is received within the bore of the cutting bit holder. Preferable the sleeve is sized so that the sleeve tightly grips or engages the bore of the cutting bit holder and does not rotate with respect to the holder. In this way, the frictional wear occurs on the confronting surfaces of the sleeve and bit shank, both of which are easily replaced. The conventional sleeves do nothing to protect other confronting surfaces of the cutting bit and bit holder. As a result, excessive wear occurs on the face of the cutting bit holder or block into which the cutting bit shank extends. After prolonged use, the wear on the face of the holder or block can become severe enough to require its replacement.

Several attempts have been made to alleviate this problem. Beebe, U.S. Patent 4,561,698, discloses a sleeve and wear protector including an annular flange manufactured as a unitary wear protector. The unitary wear protector is manufactured of materials such that the wear protector wears at a rate substantially coincident with the wear rate of the cutting bit. However, the unitary wear protector may rotate within the bore, thus leading to uneven wear of the protector assembly and wear of the holder or block. Dziak, U.S. Patent 4,489,986, discloses refers to a retainer element mounted on a cylindrical shank of a cutter bit. The cutter bit is mounted within a bore of a holder or block member. The holder or block member includes a cylindrical outer portion including a groove in which is mounted a rubber or plastic ring. The ring is received in another groove within a wear collar that contacts the cutter bit. The rubber or plastic ring further is symmetric about the axis of the cutter bit, and no means is provided to inhibit relative rotation between the collar and the holder or block member. Mercier et al., U.S. Patent 6,113,195, discloses a washer disposed between the holder and the cutting bit that is conical (Belleville) so that the washer makes annular line contact with a shoulder of the cutting bit, and

with an edge of the bore of the holder, in order to effectively seal out abrasive fines from the bore and thereby reduce the unwanted wear. No provision is made to inhibit rotation of the washer of Mercier et al, thus resulting in significant wear of the holder surface facing the washer.

O'Neill, U.S. Patent 5,106,166, discloses a unitary sleeve that has a bore for rotatably receiving a cutting bit. The sleeve and holder or block are constructed such that the angular position of the sleeve can be fixed relative to the axis of the aperture in the sleeve in any one of a plurality of discrete positions. The sleeve and holder are constructed such that the sleeve can later be rotated with respect to the axis of the aperture in the holder or block to another position and then fixed in that position. While the construction of O'Neill prevents unwanted wear of the forward facing surface of the block or holder, O'Neill requires that the block or holder have specific features not commonly present on most blocks or holders in general use. Thus, the unitary sleeve of O'Neill is cannot be used to reduce the wear of most blocks or holders in general use today. Britzke et al, U.S. Patent 5,931,542, discloses a substantially circular wear washer with a radially inwardly directed key which is adapted to fit within a slot in a sleeve surrounding the shank of the cutting bit, thereby interlocking the sleeve and the wear washer. The holder or block bore includes a keyway which is engaged a radially outwardly directed key on the sleeve thereby interlocking the retainer sleeve and wear washer with the holder or block. In the absence of such a keyway on the interior bore of the holder or block, the sleeve and washer are free to rotate.

Kammerer, U.S. Patent 6,508,516, discloses a substantially circular, planar wear washer with a radially outwardly directed key which is adapted to fit within a slot in a block or holder to prevent rotation of the washer. The washer is centered by a close fit around the shank of the cutting bit, or by soldering the washer to the sleeve within the block or holder. In the event of wear of the shank, the wear washer is able to vibrate relative to the face

of the block or holder, thus causing wear of the holder face. Thus Britzke et al, O'Neill and Kammerer require that the block or holder have specific features not commonly present on most blocks or holders in general use, and still do not completely eliminate the opportunity for significant relative movement between the wear washer and the block or holder.

What is needed is a wear washer, which is adaptable for use on a wide variety of existing holder or blocks that will inhibit or prevent wear of the forward facing surface of the holder or block. Preferably the wear washer can be coupled to a wide variety of conventional cutter bits so that the washer can be replaced with each replacement of the cutter bit.

Summary of the Invention

Accordingly, a cutter tool has a tool holder and a cutting bit as well as a washer of the present invention. The tool holder includes a holder surface having a bore extending rearward through the holder surface and an outer edge spaced from the bore. The cutting bit includes a body having a front cutting tip, a rearward projecting shank rotatably mounted in the bore of the tool holder, and a rearward facing bit shoulder disposed at a front end of the shank. The shank is rotationally symmetric about a longitudinal axis of the cutting bit. The washer is disposed between the bit shoulder and the holder surface. The washer comprises a front surface in sliding engagement with the bit shoulder, and a back surface contacting the holder surface. The back surface includes an axially asymmetric lip engaging the holder surface outer edge so as to inhibit rotation of the washer relative to the holder surface.

The cutting bit and washer can be assembled together to form a cutter assembly of the present invention. The washer includes an inner edge defining a central hole receiving the cutting bit shank. The washer also includes a front surface and a back surface joined by an outer edge of angularly variable radius. The front surface includes at least a portion for sliding contact with the rearward facing bit shoulder. The back surface

includes a lip extending rearward from only a segment of the asymmetric edge for engaging an outer shoulder of a holder. The lip can be a linear rearward extension along an outer edge of the back surface of the washer. Where the washer outer edge is in the form of an ellipse, the lip can also be positioned on the back surface of the washer on a major axis of the ellipse. A sleeve surrounding the cutting bit shank includes a forward edge positioned to confront the back surface of the washer adjacent the inner edge for retaining the washer on the cutting bit adjacent to the rearward facing bit shoulder. The washer central hole includes a smooth inner surface that facilitates rotation of the cutting bit relative to the washer.

The portion of the washer in sliding contact with the rearward facing bit shoulder is generally a circular ring portion. The washer front surface can include an outer tapered portion tapering away from the circular ring portion. The washer front surface can also include an inner tapered portion. Both the inner and outer tapered portions taper away from the circular ring portion in sliding contact with the rearward facing bit shoulder. The outwardly tapered surface tends to inhibit particulate abrasive material from penetrating passed the circular ring contact portion, and thus concentrates any frictional wear into a circular pattern on the rearward facing bit shoulder and the forward facing surface of the washer. Thus, the tool holder forward surface and the tool holder bore experience reduced wear, which contributes to enhanced usable life for the tool holder and more reliable positioning of the cutting bit in relation to the work surface.

These and other features and advantages of the present invention will become apparent from the following description of illustrative embodiments of the present invention. The description makes reference to the accompanying drawings.

Brief Description of the Drawings

Figure 1 is an exploded view of a cutter tool including a tool holder and a cutting bit as well as a washer of the present invention.

Figure 2 is a side elevation view of a washer of the present invention.

Figure 3 is a side elevation view of a cutting bit and washer assembly of the present invention, the washer and sleeve being shown in section.

Figures 4A and 4B are perspective views of the top and bottom of one embodiment of a washer of the present invention.

Figures 5A and 5B are perspective views of the top and bottom of another embodiment of a washer of the present invention.

Figure 6 is a side elevation view of the washer of Figures 4A and 4B.

Figure 7 is an exploded perspective view of another cutter tool including a tool holder and a cutting bit as well as a washer of the present invention.

Figure 8 is another exploded perspective view of a further cutter tool including a tool holder and a cutting bit as well as a washer of the present invention.

Figure 9 is a side elevation view of a cutter tool including a tool holder and a cutting bit as well as a washer of the present invention.

Description of Preferred Embodiments

Figure 1 illustrates one embodiment of a cutter tool 10 of the present invention. The cutter tool 10 includes a tool holder 12, a cutting bit 14 and a washer 16. The tool holder 12 includes a body 18 having a holder surface 20. The body 18 includes a bore 22 extending through the holder surface 20 and body 18. The bore 22 can include a relieved portion such as the beveled or chamfered portion 23. An outer edge 24 is spaced from the bore 22 typically by a distance that varies around the perimeter of the body 18. The tool holder 12 is generally secured to other apparatus, such as a milling drum (not shown), by a weld around the bottom perimeter 26.

The cutting bit 14 includes a body 28 having a front cutting tip 30 and a rearward facing shoulder 32. Any number of flutes and scallops can be

present on the outer surface of the body 28 between the tip 30 and the rearward facing shoulder 32. A shank portion 34 projects rearward from the center of the rearward facing shoulder 32. The shank portion 34 can be seen to be rotationally symmetric about a longitudinal axis Y of the cutting bit 14. A sleeve 36, typically constructed of a spring steel, surrounds the cutting bit shank portion 34 and is held on to the shank portion 34 by a rearward edge 38 of the sleeve 36 confronting a radially protruding lip 40 adjacent the rear end 42 of the shank portion 34. The sleeve 36 has an outer diameter equal to or slightly exceeding the inner diameter of the bore 22 so as to be tightly received therein. The sleeve 36 has an inner diameter that is greater than the diameter of the shank portion 34 so as to fit somewhat loosely thereon. The cutting bit 14 is thus able to rotate with respect to the sleeve 36 and the tool holder 12 when the shank portion 34 of the cutting bit 14 is received in the bore 22 of the tool holder 12.

The washer 16 is disposed between the cutting bit rearward facing shoulder 32 and the tool holder surface 20. The washer 16 includes a front surface 44 in sliding engagement with the bit rearward facing shoulder 32. A back surface 46 of the washer 16 contacts the tool holder surface 20. The back surface 46 includes an axially asymmetric lip 48 for engaging the outer edge 24 of the tool holder 12 so as to inhibit rotation of the washer 16 relative to the tool holder surface 20. The washer 16 includes a smooth inner bore 50 that facilitates rotation of the cutting bit 14 relative to the washer 16. The inner bore 50 is surrounded by an axially symmetric protruding portion such as sloping or tapered portion 52 that is received in the beveled or chamfered portion 23 of the tool holder 12 surrounding the bore 22. The diameter of the bore 50 is preferably slightly smaller than the outside diameter of sleeve 36. A perimeter surface 54 connects an outwardly tapered portion 56 of the front surface 44 to the back surface 46.

The perimeter surface 54 is of varying radius measured from the center of the bore 50, which is coincident with the axis Y of the cutting bit 14.

In the embodiment illustrated in Figures 2 and 3, the outwardly tapered portion 56 is seen to extend over a greater fraction of the washer 16 than the inwardly tapered portion 52. The washer front surface 44 is also seen to have a circular ring portion 58 between the inner tapered portion 52 and the outwardly tapered portion 56 that is in sliding contact with the rearward facing bit shoulder 32. This larger outwardly tapered portion 56 acts to direct abrasive particulate matter away from the ring portion 58, thus reducing the rate of wear experienced by the washer 16 and bit 14. The back surface 46 also includes an inner edge 60 that is in contact with a forward facing edge 62 of the sleeve 36, thereby retaining the washer 16 and cutting bit 14 together as an easily handled combination. The back surface 46 also includes a protruding portion such as the tapered portion 64 that is adapted to be received in the beveled or chamfered portion 23 in holder 12.

The perimeter surface 54 of the washer 16 can assume a number of shapes that are suitable for use in the present invention. Figures 4A and 4B show a washer 16 with an outer edge 54 in the form of an ellipse. The lip 48 is positioned on the back surface 46 of the washer 14 on a major axis X of the ellipse. In Figures 5A and 5B, the washer 16 is shown to have a rectangular outer perimeter surface 54. The lip 48 is seen to have the form of a linear rearward extension along an outer edge of the back surface 46 of the washer 16. Other perimeter shapes that can be employed for the present invention will be apparent to those skilled in the art based on the forgoing examples. In each situation the perimeter surface 54 is seen to be of varying radius measured from the center of the bore 50. Further the area of the forward surface 44 in contact with the rearward facing bit shoulder 32 can be varied so as occupy a smaller portion as in Figures 2 and 3, or a larger portion as in Figures 4-6 wherein

the forward surface 44 is substantially planar and having only a very minor outwardly tapered portion 56.

Another cutter tool 70 including a tool holder 72 and a cutting bit 74 as well as a washer 76 is shown in Figure 7. The tool holder 72 includes a body 78 having a holder surface 80. The body 78 includes a bore 82 extending through the holder surface 80 and body 78. The bore 82 includes a relieved portion such as the beveled or chamfered portion 83. An outer edge 84 is spaced from the bore 82 typically by a distance that varies around the perimeter of the body 78. The outer edge 84 can include one or more protruding portions 85. The tool holder 72 is generally secured to other apparatus, such as a milling drum (not shown), by a weld around the bottom perimeter 86.

The cutting bit 74 can be similar in construction to cutting bit 14 shown in Figures 1 and 3. The cutting bit 74 includes a body 28 having a front cutting tip 30 and a rearward facing shoulder 32. Any number of flutes and scallops can be present on the outer surface of the body 28 between the tip 30 and the rearward facing shoulder 32. A shank portion 34 projects rearward from the center of the rearward facing shoulder 32. The shank portion 34 can be seen to be rotationally symmetric about a longitudinal axis Y of the cutting bit 74. A sleeve 36, typically constructed of a spring steel, generally surrounds the cutting bit shank portion 34 and is held on to the shank portion 34 by a rearward edge 38 of the sleeve 36 confronting a radially protruding lip 40 adjacent the rear end 42 of the shank portion 34. The sleeve 36 has an outer diameter equal to or slightly exceeding the inner diameter of the bore 82 so as to be tightly received therein. The sleeve 36 has an inner diameter that is greater than the diameter of the shank portion 34 so as to fit somewhat loosely thereon. The cutting bit 74 is thus able to rotate with respect to the sleeve 36 and the tool holder 72 when the shank portion 34 of the cutting bit 74 is received in the bore 82 of the tool holder 72.

The washer 76 is disposed between the cutting bit rearward facing shoulder 32 of the cutting bit 74 and the tool holder surface 80. The washer 76 includes a front surface 90 in sliding engagement with the bit rearward facing shoulder 32. A back surface 92 of the washer 76 contacts the tool holder surface 80. The washer 76 includes an axially asymmetric lip 94 that connects an outwardly tapered portion 88 of the front surface 90 to the back surface 92. The asymmetric lip 94 is of varying radius measured from the center of the bore 96, which is coincident with the axis Y of the cutting bit 74. The asymmetric lip 94 also engages an upwardly protruding portion 85 the outer edge 84 of the tool holder 72 so as to inhibit rotation of the washer 76 relative to the tool holder surface 80. The washer 76 includes a smooth inner bore 96 that facilitates rotation of the cutting bit 74 relative to the washer 76. The inner bore 96 is surrounded by an axially symmetric protruding portion 98 that is received in the beveled or chamfered portion 83 of the tool holder 72 surrounding the bore 82. The engagement between the axially symmetric protruding portion 98 and the chamfered portion 83 inhibits lateral movement of the washer 76 relative to the tool holder surface 80. The diameter of the bore 96 can be slightly smaller than the outside diameter of sleeve 36 so that the washer 76 can be retained on the shank portion 34 of the cutting bit 74. The sleeve 36 surrounding the cutting bit shank portion 34 can include a forward edge 37 confronting the protruding portion 98 of the back surface 92 of the washer 76 to retain the washer 76 on the cutting bit 74 adjacent to the rearward facing bit shoulder 32.

Another washer 100 is shown in Figure 8 that can also be used in combination with the tool holder 72 and cutting bit 74 described in connection with Figure 7. The washer 100 is disposed between the rearward facing shoulder 32 of the cutting bit 74 and the tool holder surface 80. The washer 100 includes a front surface 102 in sliding engagement with the bit rearward facing shoulder 32. A back surface 104

of the washer 100 contacts the tool holder surface 80. The washer 100 includes an axially asymmetric lip 106, which is shown to be rectangular or square, that joins the perimeters of the upper and lower surfaces 102 and 104. The asymmetric lip 106 can engage the upwardly protruding portion 85 the outer edge 84 of the tool holder 72 so as to inhibit rotation of the washer 100 relative to the tool holder surface 80. The washer 100 includes a smooth inner bore 108 that facilitates rotation of the cutting bit 74 relative to the washer 100. The diameter of the inner bore 108 can be slightly smaller than the outside diameter of sleeve 36 so that the washer 100 can be retained on the shank portion 34 of the cutting bit 74 by a forward edge 37 of the sleeve 36. The inner bore 108 is surrounded by an axially symmetric protruding portion 110. The protruding portion 110 is adapted to be received in the beveled or chamfered portion 83 of the tool holder 72 surrounding the bore 82. The engagement between the axially symmetric protruding portion 110 and the chamfered portion 83 inhibits lateral movement of the washer 100 relative to the tool holder surface 80.

Figure 9 shows the assembled cutter tool 70 consisting of the tool holder 72 and a cutting bit 74, as previously described, as well as a washer such as washer 76 or 100. The washer 76, 100 is seen to have a front surface 90 including an outwardly tapered portion 88. The washer 76, 100 also includes an axially symmetric protruding portion 98, 110 as previously shown in Figures 7 and 8 which on the front surface of the washers forms an inwardly tapered portion similar to portion 52 shown in Figures 3, 4A and 5A. The junction of the outwardly tapered portion 88 of the front surface 90 and the protruding portion 98, 110 defines a circular ring portion 89 between the inner tapered portion and the outwardly tapered portion 88. This circular ring portion 89 is in sliding contact with the rearward facing bit shoulder 32 of bit 74. The larger outwardly tapered portion 88 acts to direct abrasive particulate matter away from the ring

portion 89, thus reducing the rate of wear experienced by the washer 76, 100 and bit 74.

Thus the replacable wear washers 16, 76 and 100 are adapted for use on a wide variety of existing holder or blocks 18, 72 to inhibit or prevent wear of the forward facing surface20, 80 by virtue of either lateral or rotational motion of the washer relative to the holder or block 18, 72. A wear washer 16, 76 100 can be coupled to a wide variety of conventional cutter bits 14, 74 so that the washer can be replaced by each replacement of the cutter bit. The replacable wear washers 16, 76 and 100 also act to exclude abrasive material from between the parts of the cutter tool 10, 70 that are moving relative to each other so that the working life of the cutter bit and tool holder are extended.

Although the present invention has been described in connection with preferred embodiments thereof, those skilled in the art will appreciate that additions, deletions, modifications, and substitutions, although not specifically described, can be made without departing from the spirit and scope of the invention as defined in the appended claims.